Total Maximum Daily Load Studies for Dissolved Oxygen and Fecal Coliform Bacteria in the Lower Skagit River

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Introduction

The Skagit River basin has a drainage area of approximately 3,093 square miles, which includes its headwaters in British Columbia. It is the largest basin tributary to Puget Sound, and the largest basin in Washington outside the Columbia River. The study area for this project is the lower Skagit River, which is the lowland portion of the river downstream from the lower end of Skiyou Slough near Sedro-Woolley. Just before the Skagit drains into Skagit Bay, it splits into the North and South Forks, which bound Fir Island. The Lower Skagit Study Area drains an area of about 200 square miles. Figure 1 presents a map of the study area.

The principal land uses in the study area are agriculture, forestry, and urban areas. Both dairy farming and row cropping are widespread in the study area. The three main population centers are Mount Vernon, Burlington, and Sedro-Woolley. Much of the study area is diked and drained, and several pump stations discharge water from the drainage districts into the Skagit River.

A water quality study was conducted in the lower Skagit River to evaluate the effects of point and nonpoint pollutant loading on dissolved oxygen (DO) and fecal coliform (FC) bacteria levels. Rapid growth in Skagit County has prompted concerns that increased wastewater discharges could degrade DO in the Skagit River. Low DO levels could contribute to impairment of Skagit River salmon. FC bacteria are an indicator of pathogens from sewage and manure. High FC levels could pose a public health threat to recreational users of the Skagit River, and could also degrade shellfish beds near the mouth of the river. FC bacteria levels historically have exceeded state standards in the Skagit River and its tributaries, and shellfish beds in Skagit Bay have been subject to harvest restrictions.

The Surface Water Quality Standards for Washington State are described in state regulations (Chapter 173-201A WAC). The Skagit River and its tributaries in the study area are subject to Class A fresh water Standards, with the exception of the upstream end of the study area (the Skagit River above Sedro-Woolley, at the lower end of Skiyou Slough), which is subject to Class AA standards. Skagit Bay is a Class A marine water, and the boundary between marine and freshwater standards occurs somewhere downstream of the study area.

If water quality standards are not being met or are threatened by existing pollutant sources, then a Total Daily Maximum Load (TMDL) may be established to regulate acceptable pollutant loads, as required under Section 303(d) of the Federal Clean Water Act. A TMDL technical study evaluates the combined effects of various sources in the basin to determine the loading capacity of pollutants that will protect the water quality standards and protect beneficial uses for the basin. Alternative TMDLs are recommended that may be allocated to point sources and nonpoint or background sources. The allocations may be implemented through NPDES permits, state waste discharge permits, grant projects, watershed action plans, and other nonpoint source control activities.

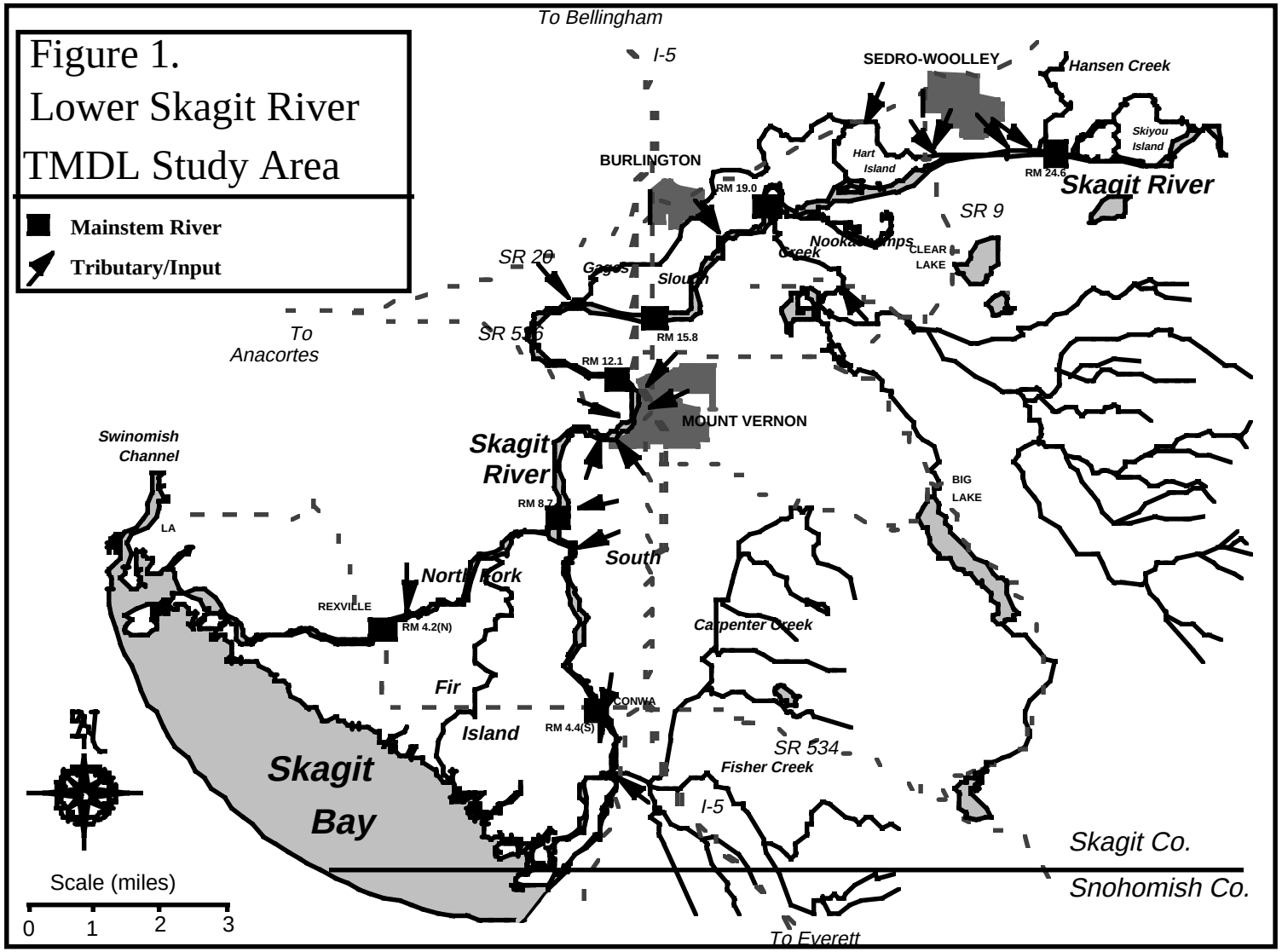

Figure 1. Study area in the lower Skagit River.

Study Description

Water quality surveys were conducted for 10 weeks from December 1994 through October 1995. The design for this study was described in detail in the Quality Assurance Project Plan (Pickett, 1995). Sampling sites, shown in Figure 1, included four municipal wastewater treatment plant discharges (Sedro-Woolley, Burlington, Mount Vernon, and Big Lake), tributary streams, drainage district pump stations, urban stormwater sources, and combined sewer overflows (CSOs). Surveys included samples for laboratory analysis, field measurements, and remote half-hourly measurements by multi-parameter data-loggers.

A summary of the data collected as part of this study was published in Pickett (1996). The data summary report includes complete tables of field measurements and laboratory analytical results. Pickett (1996) also gives a detailed summary of the data Quality Assurance/Quality Control analysis. A complete description of the TMDL analysis and results was published in Pickett (1997).

Dissolved Oxygen TMDL Analysis

The loading capacity of the lower Skagit River for Biochemical Oxygen Demand (BOD) was determined through computer modeling and other data analyses. HEC-RAS, a flow-routing model provided by the U.S. Army Corps of Engineers, was used for modeling velocity, time of travel, and the split of flow between the North and South Forks. Modeling of DO was done with Multi-SMP, a simple DO model developed under EPA contract. CORMIX was used to evaluate mixing effects near the Mount Vernon wastewater discharge and the split of pollutant loading from that discharge to the two forks.

The analysis of loading capacity produced the following results:

- The critical location for low DO in the lower Skagit River was found to be in the South Fork near Conway.
- TMDLs were proposed for carbonaceous BOD (CBOD) and ammonia. The Skagit River has the capacity to assimilate current design levels of CBOD and ammonia nitrogen from permitted point source discharges without violation of the dissolved oxygen water quality standards.
- The proposed TMDL provides capacity for future levels of CBOD and ammonia point source loading, if the allocations are met during the dry season critical low-flow period (July through October). Allocations to each point source are proposed based on 2015 effluent flows; ammonia nitrogen concentrations of 10 mg/L or current levels (whichever is less); and BOD concentrations of 20 mg/L. Figure 2 illustrates these proposed allocations.
- Effluent monitoring is recommended for ammonia nitrogen for all point sources. Ambient monitoring is recommended for DO in the South Fork Skagit River at the Conway bridge during neap high tide conditions.

Fecal Coliform Bacteria TMDL Analysis

The loading capacity of the lower Skagit River for FC bacteria was determined through modeling and data analyses with computer spreadsheets. Mass balances were developed for flow and FC bacteria for each survey. To predict flows for ungaged inputs, empirical relationships were developed from observed data. A first-order decay coefficient was applied to the FC mass balances. Unidentified sources were added to the FC mass balances where data indicated that those sources were present.

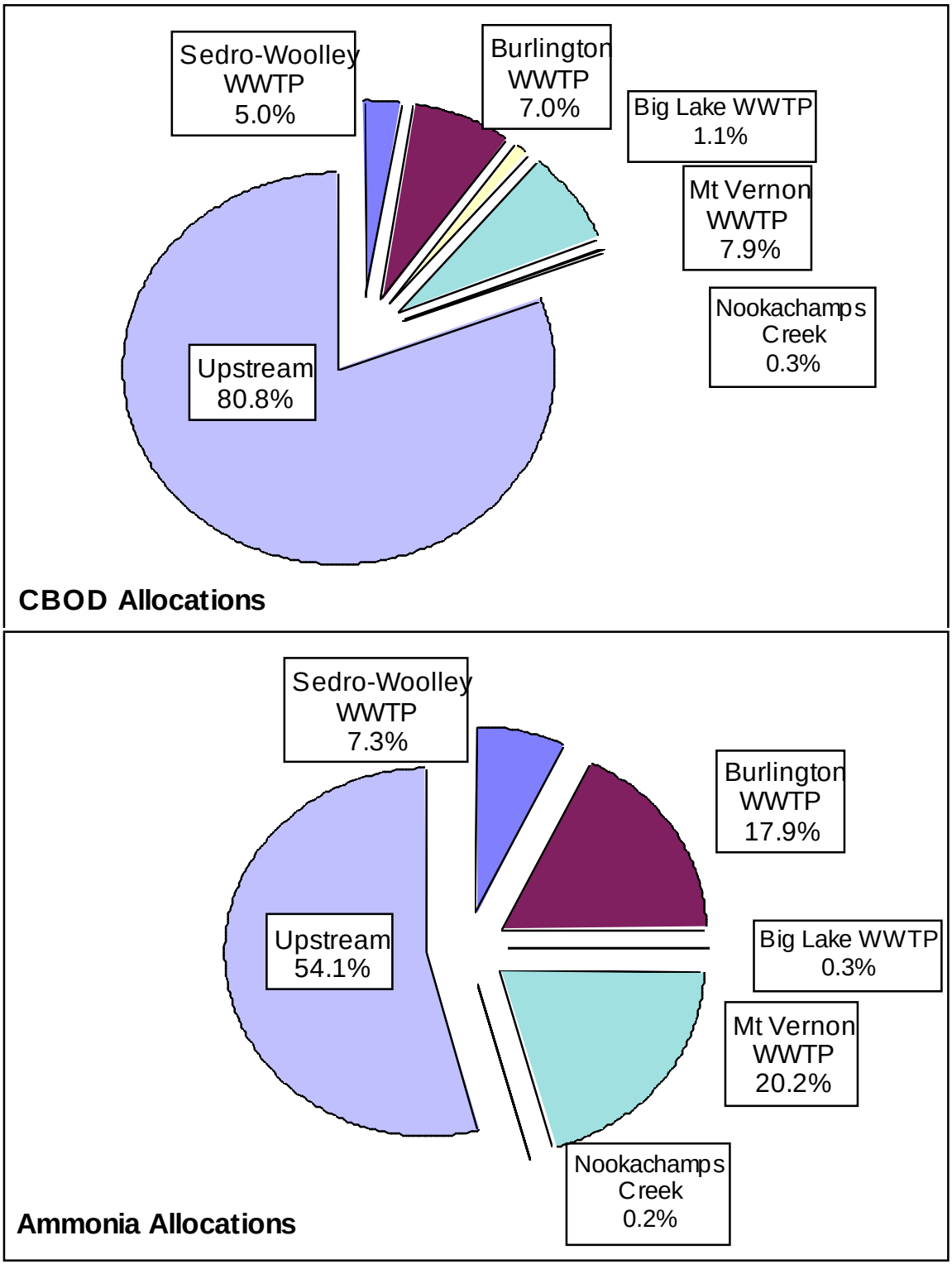

Figure 2. Lower Skagit TMDL CBOD and ammonia allocations (for 2015 Critical Conditions TMDL Alternative).

Using the mass balances and other data analyses, the loading capacity of the lower Skagit River for FC bacteria was determined and TMDLs were proposed to protect the water quality standards for FC bacteria. Target values for FC bacteria in the Skagit River were developed to ensure that marine water quality standards for FC bacteria would be met at the river's mouths. The FC bacteria analysis produced the following results:

- Current FC bacteria levels exceed Class A fresh water quality standards in many tributaries of the lower Skagit River, exceed Class AA standards in the Skagit River upstream of Sedro-Woolley, and very likely exceed the Class A marine standards at the mouths of the North and South Forks of the Skagit River.
- A FC bacteria TMDL is proposed in which marine water quality standards will be protected in Skagit Bay at the mouth of the Skagit River if the following conditions are met: 1) all permitted point sources meet their current permit limitations; 2) Mount Vernon CSOs discharge no more than once per year; 3) the Skagit River above Sedro-Woolley meets target values below the Class AA standards (6 cfu/100 mL geometric mean and less than 10% of values above 80 cfu/100 mL); 4) Nookachamps, Carpenter, and Fisher Creeks meet freshwater standards; and 5) loading sources at the Rexville pump station (Drainage District 15) and an unidentified source upstream of Kulshan Creek are significantly controlled.
- Addressing the long-term goal of having all tributary surface waters meet the Class A water quality standards will provide an additional margin of safety to the Skagit River and Skagit Bay. As resources allow, watershed plans and other nonpoint source control programs should be developed and fully implemented in watersheds, drainage districts, and other stormwater drainage areas that currently do not meet the standards.
- Long-term monitoring is necessary in the Skagit River (North and South Forks and above Sedro-Woolley) and in tributary waters to evaluate the FC bacteria TMDL.

References

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